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22 August 2024

8:00 am – 9:00 am | PDT, Los Angeles
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5:00 pm – 6:00 pm | CEST, Berlin, Madrid

Avoiding costly risks for solar assets



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Welcome!

Do you have any questions?  

Send them in via the Q&A tab.  We aim to answer as many as we can today!

You can also let us know of any tech problems there.

We are recording this webinar today. 

We'll let you know by email where to find it and the slide deck, so you can re-watch it at your convenience.  



Avoiding Costly Risks for Solar Assets

Protecting ROI

Ankil Sanghvi (Sr. Engineering Manager, ES)

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PV Magazine Webinar

22 August 2024



Project Economics – By Stage

How do economics evolve through the life of the PV Solar system?

DESIGN	CONSTRUCTION	OPERATIONS
Rapid Decisions/Changes	Minimal Changes	No Changes Possible
Medium Duration (1 yr+)	Short Duration (3-6 months)	Very Long Duration (20-30 yrs)
Low Investment (\$0.10 - \$0.40/watt)	Very High Investment (\$1.50 - \$2.50/watt)	Minimal OPEX Investment (\$0.01 - \$0.03 /watt /yr)
No Earned Revenue	No Earned Revenue	Seasonal Revenue (\$0.01 - \$0.03 /watt /month)

Maximizing Return on Investment (R.O.I.)

Keeping your mind on your money, and your money on your mind

REDUCE INVESTMENT

- Make design changes early
- Shop around for best prices
- Pay attention to markets, regulations, and opportunities.

MAXIMIZE RETURNS

- Know the LCOE
- Use the most precise tools
- Seek expert help

ELIMINATE VOLATILITY

- Monitor closely
- React quickly
- Protect life, safety, and property

Time Is Money

Avoiding schedule overruns in design

DETAILED SCHEDULING

- Start with a detailed Work Breakdown Structure (WBS)
- Know the prerequisites, dependents, and durations
- Use partners and experts to fill in information gaps

TRACKING AND ADJUSTING

- Know the critical path, float
- Communicate to all parties.
- Use a Look-Ahead
- Implement strong Stage-Gate processes.

AVOID REWORK

- Activities Out-of-Sync can delay or require rework
- Correcting errors can trigger re-submittals for permits
- Can result in costly Change Orders from multiple parties

Biggest Risks for Solar Assets

ROI Assassins

Design Errors and Omissions



Biggest Risks for Solar Assets

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Design Errors and Omissions



Cost and Schedule Overruns

Biggest Risks for Solar Assets

ROI Assassins

Design Errors and Omissions



Cost and Schedule Overruns

System Downtime and Underperformance



Biggest Risks for Solar Assets

ROI Assassins

Design Errors and Omissions



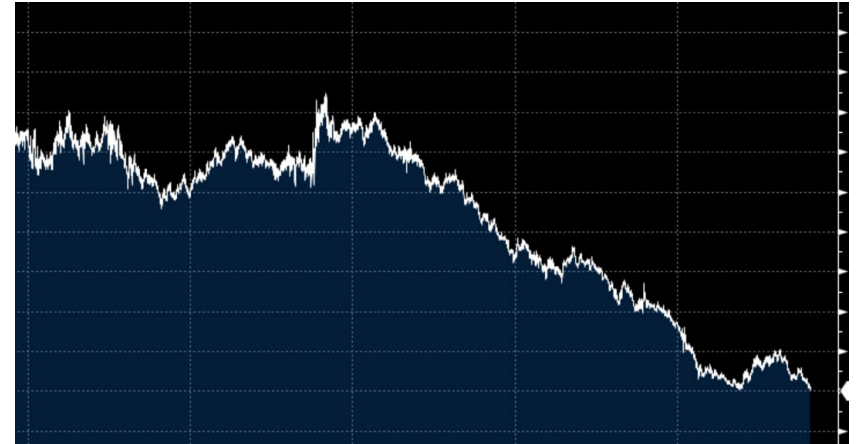
Cost and Schedule Overruns



System Downtime and Underperformance



Thermal Events and Property Damage



What are the Costs? – Design / Construction

Example System:

1 MW – Flat Roof

20 yr Life

What happens if you discover an unexpected site constraint, at different stages?

	Discovered During Design Diligence	Discovered During Construction Phase	Discovered During Operations
The Issue	<ul style="list-style-type: none"> Engineer discovers an unmapped rooftop HVAC unit during pre-design site walk. 	<ul style="list-style-type: none"> During construction, the GC discovers an unmapped rooftop HVAC unit. 	<ul style="list-style-type: none"> After heavy snowstorm, roof starts sagging. HVAC had been upgraded to heavier units just prior to PV installation, now roof is overloaded.
The Effects	<ul style="list-style-type: none"> Design Engineer works in CAD for 1 week to adjust layout. 	<ul style="list-style-type: none"> Design Engineer adjusts layout. 1 wk, Cost = \$4,000 Resubmit Building Permit. 3 wk delay. Contractor stop work 4 wks. Change Order = \$5k-\$10k 	<ul style="list-style-type: none"> Remove one 100 kW array from roof. Cost = \$15k Lose 10% site production. Cost = \$600k Design Engineer modifies as-builts. Cost = \$4,000
The Costs	<ul style="list-style-type: none"> Cost = \$4,000 		
	Total = \$4,000	Total = \$14,000	Total = \$619,000

What are the Costs? – Permitting and Environmental

Example System:

1 MW – GFT

30 yr Life

What happens if you miss a critical permit or study?

	Discovered During Design Diligence	Discovered During Construction Phase	Discovered During Operations
The Issue	<ul style="list-style-type: none"> Environmental Site Assessment (ESA) reveals endangered species habitat in 10% of site. 	<ul style="list-style-type: none"> During site clearing, neighbor spots an endangered species in the construction area, and alerts authorities. 	<ul style="list-style-type: none"> State Wildlife Board issues citation for destroying wildlife habitat. Removal and Restoration required
The Effects	<ul style="list-style-type: none"> Design Engineer works in CAD for 1 week to adjust layout. 	<ul style="list-style-type: none"> ESA must be performed. 5 wk delay State Wildlife Board reviews and issues recommendations. 3 wk delay 	<ul style="list-style-type: none"> Remove one 100 kW block from site. Cost = \$20k-\$30k Land restoration. Cost = \$200k Lost Production from -100 kW for 30 years. Cost = \$810k Engineer revises as-builts. Cost \$4,000
The Costs	<ul style="list-style-type: none"> Cost = \$4,000 	<ul style="list-style-type: none"> Engineer revises layout. Cost \$4,000 Contractor stop work 8 wks. Change Order = \$20k-\$30k 	
	Total = \$4,000	Total = \$24,000	Total = \$1,044,000

What are the Costs? – Energy Modeling

Example System:

1 MW – Flat Roof

20 yr Life

What can happen if you use imprecise assumptions in PVSyst?

	Discovered During Design Diligence	Discovered During Construction Phase	Discovered During Operations
The Issue	<ul style="list-style-type: none"> PVSyst model is reviewed by 3rd party and found to have minorly incorrect assumptions for Soiling, GHI, and other losses. 	<ul style="list-style-type: none"> Capacity Test is performed, and system passes. 	<ul style="list-style-type: none"> The system is operating without faults, but production is below expectations
The Effects	<ul style="list-style-type: none"> After performing side-by-side model comparison, engineer determines specific production is being overestimated by 9.2% IE issues report which identifies areas to be corrected in the model 	<ul style="list-style-type: none"> Since Capacity Test does not account for long term soiling or annual GHI, this modeling issue will not be discovered at this stage. 	<ul style="list-style-type: none"> IE Performance Ratio and PVSyst Modeling Report ordered. Cost = \$20,000 It is determined that original model overestimated production by 9.2% Lost Production over lifetime = \$564,000
The Costs	<ul style="list-style-type: none"> Cost = \$15,000 		
	Total = \$15,000 / \$0		Total = \$584,000

Biggest Risks for Solar Assets

ROI Assassins

Design Errors and Omissions

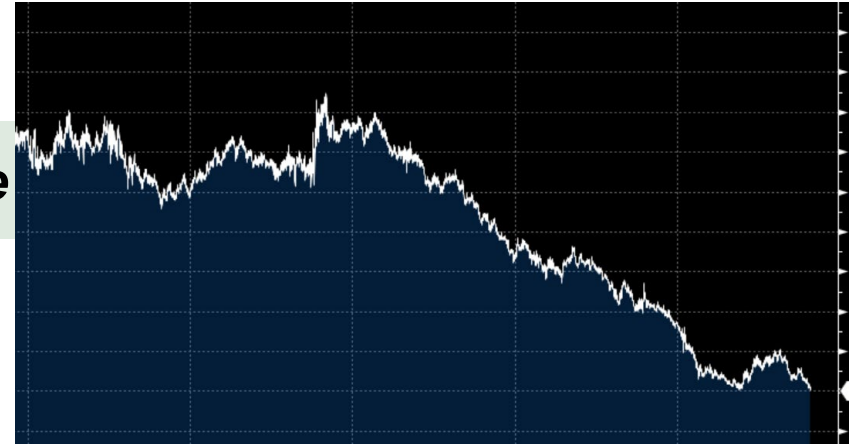


Cost and Schedule Overruns

System Downtime and Underperformance



Thermal Events and Property Damage



Safety Problems Are More Common Than Many Realize

730

CEA Has Performed Over 700 PV
Safety Audits

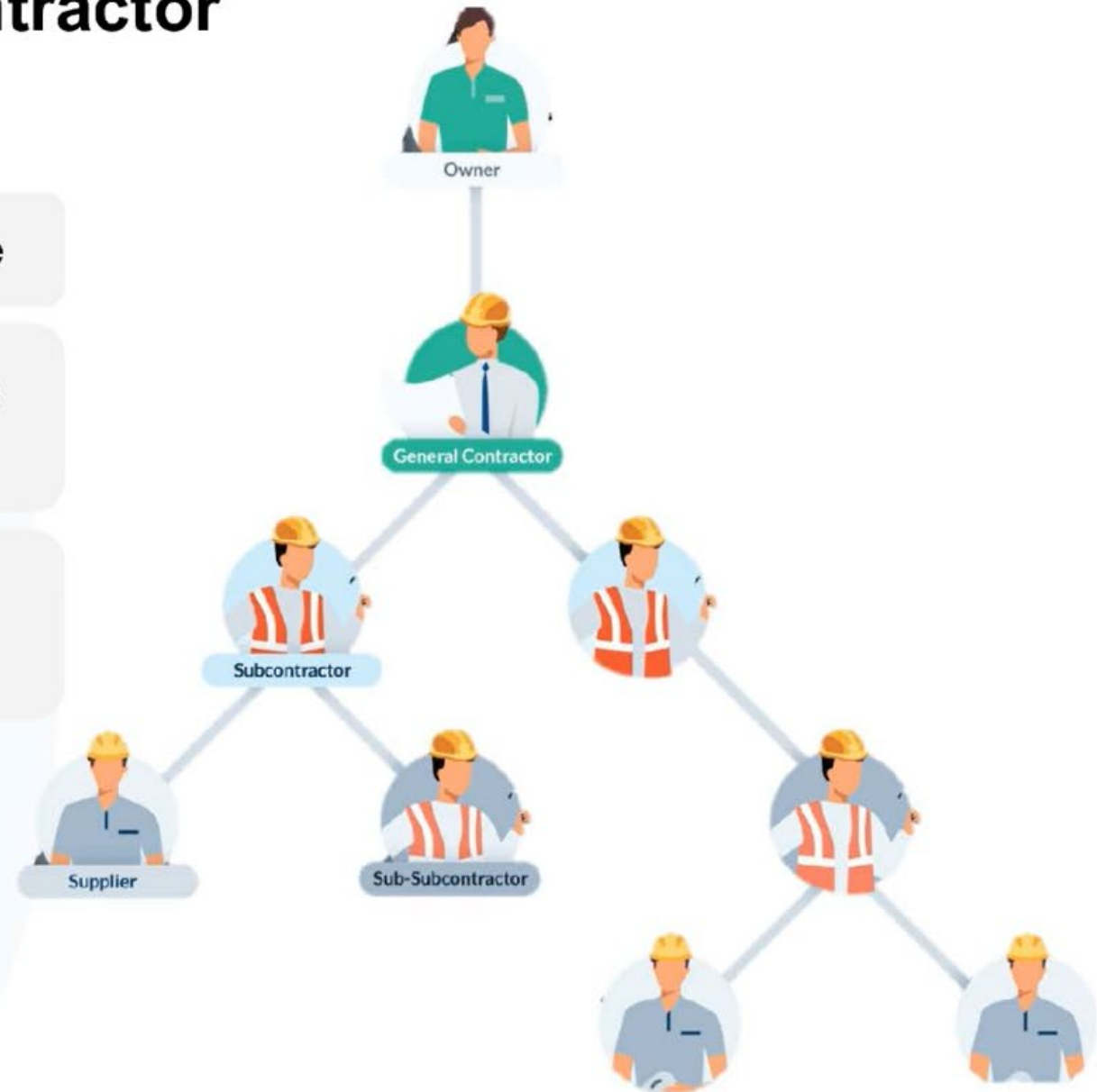
94%

94% Of Audited Systems in 2024
Had Major Safety Concerns
...down from 97% in 2023

Your Contractor's Contractor's Contractor

Incentives are typically not aligned...

- Pressure to reduce costs and deliver projects on-time
- Does the installation team have a long-term incentive for safety?
- Does the maintenance team look for potential safety risks or only correct issues?



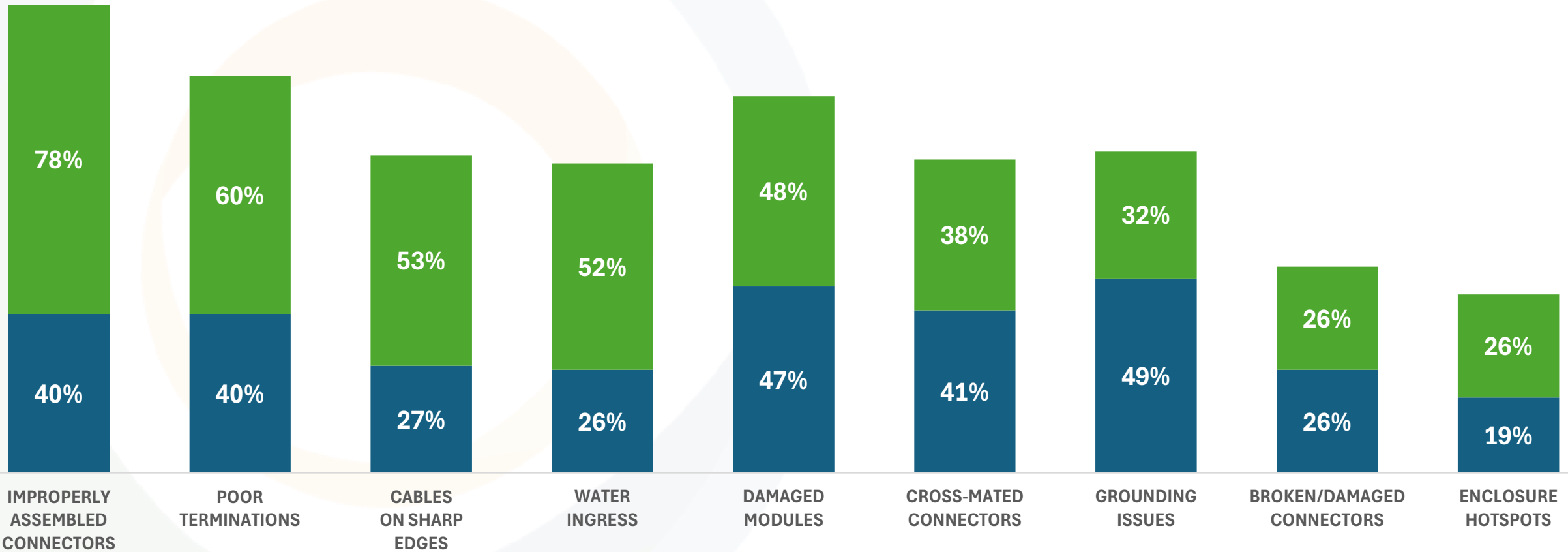


Thermal Events Can Be Avoided...

It's not rocket science. It's DUE DILIGENCE.

Common Issues Seen in PV Systems Based On CEA Inspections

■ 2023 ■ 2024



Case Study: Thermal Event 1

Issues Observed

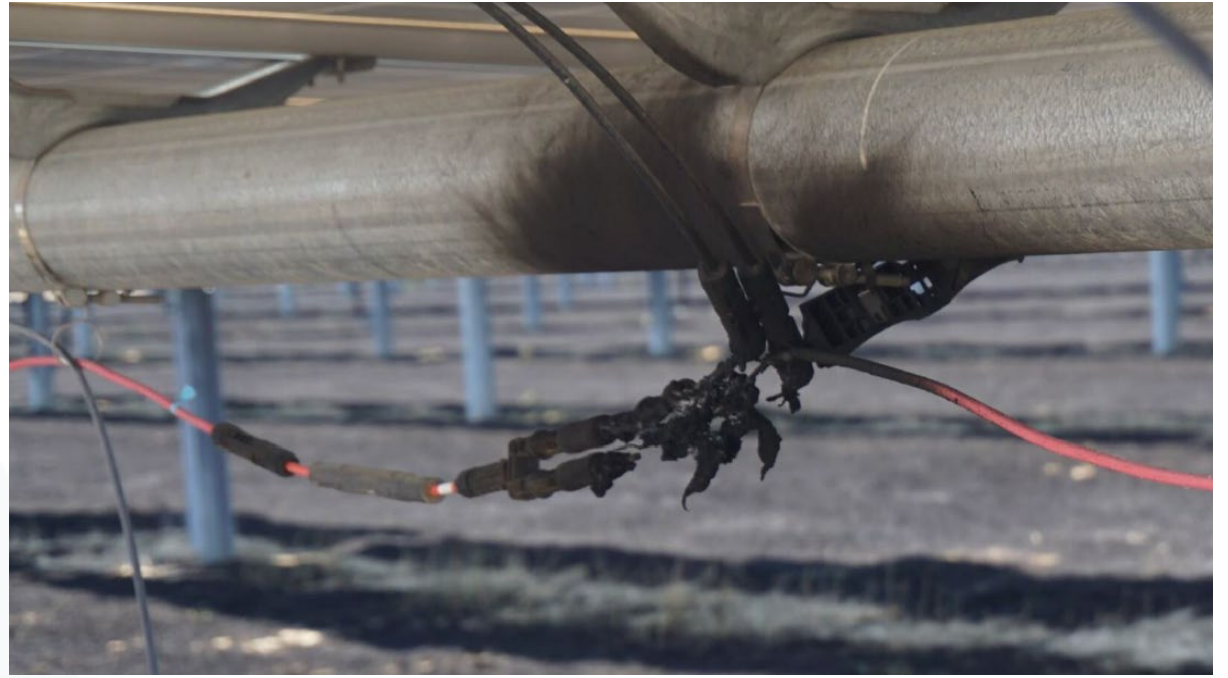
- Cables not secured and supported
- Cables found not routed correctly through trackers
- Connectors found not crimped to specifications
- Damage to module junction boxes

Revenue Impact

- Loss in revenue due to loss in production
- Multiple thermal events observed in same system
- Utility scale system above 150 MW at risk of losing insurance
- Loss of insurance due to multiple thermal events

Pictures





Wire Management

Wire Management has been a major cause of multiple thermal events in 2024. Loose and unsecured cables, improper routing of cables, cables on sharp edges have been cause of thermal events on sites.

Case Study: Thermal Event 2

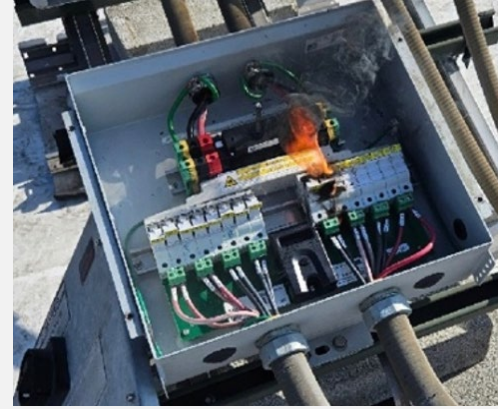
Issues Observed

- Kitting of equipment
- Inverters installed 180 degrees parallel to the roof
- Cinder Blocks pinched the cables

Revenue Impact

- Loss of revenue due to damage to the system
- The client had to evacuate a commercial building for a day

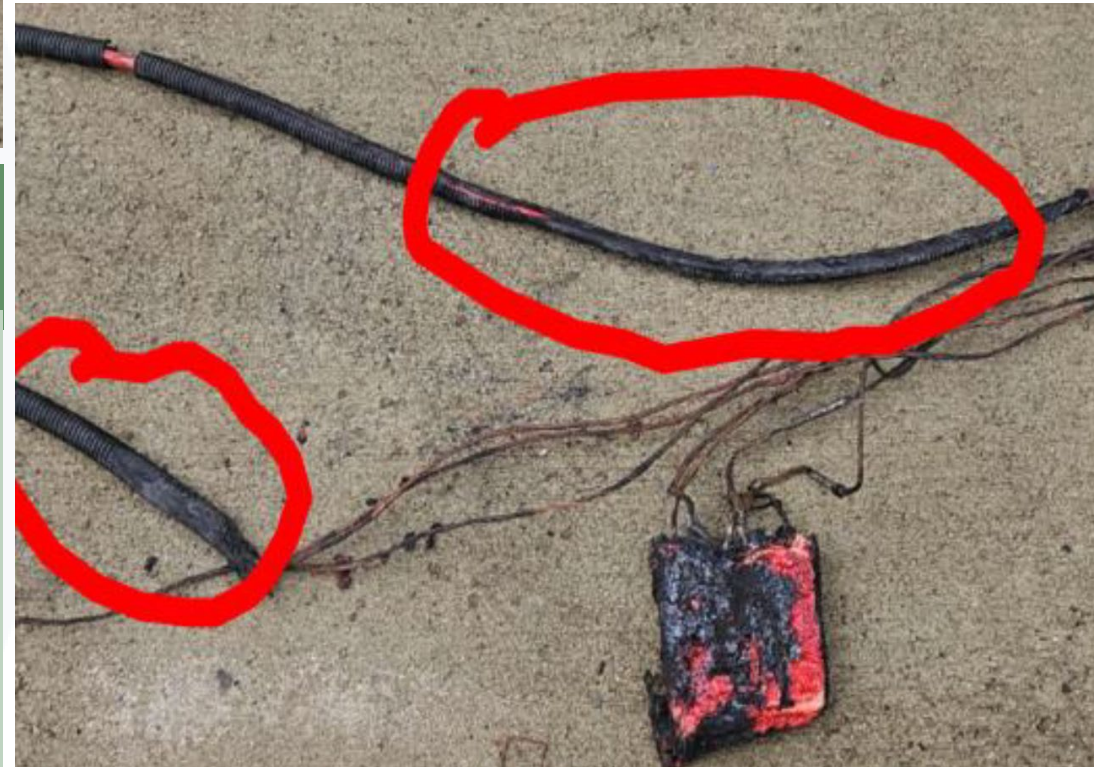
Pictures





Wire Management Issues

CEA found wire management-related issues to be the primary cause of thermal events for this site. Thermal event debris was cleaned up before CEA reached onsite. CEA found all equipment in a dumpster and noticed damaged insulation due to pinching on cables.



Case Study: Thermal Event 3

Issues Observed

- Cross Mated Connectors
- Connectors not assembled correctly
- Connectors Not Seated

Revenue Impact

- Loss of revenue due to damage to the system
- Client asked EPC to de-energize multiple of sites following the thermal event
- Client lost produce inside store of about \$200k due to loss of freezing system in building.

Pictures





Connector Assembly Issues

Connector Assembly Issues were the primary cause of the thermal event, for this client, crossmated connectors were found, and manufacturer assembly guidelines were not followed.



What Are The Costs? – Manuals And Warranties

Example System:
1 MW – Flat Roof
20 yr Life

What happens if you contractor doesn't follow the manual?

	Discovered During Design Diligence	Discovered During Construction Phase	Discovered During Operations
The Issue	<ul style="list-style-type: none"> Contractor submits bid where they substitute 1 x 2" conduit, instead of 2 x 1" conduits shown on drawings. 	<ul style="list-style-type: none"> During commissioning, the inspector notices poorly sealed conduits due to improper size and entry point. 	<ul style="list-style-type: none"> Water intrusion at an inverter causes thermal event. Entire system shut down for 4 weeks.
The Effects	<ul style="list-style-type: none"> Engineer recognizes violation of inverter installation manual Engineer issues RFI which mandates 1" maximum conduit size and requires contractor to revise bid. 	<ul style="list-style-type: none"> Affected conduits were removed and re-installed throughout the site. Cost = \$12,000, 2 wk delay Repair inverter enclosure. Parts Cost = \$10k, Installation = \$11k, 4 wk delay Contractor stop work 4 wks. Change Order = \$10k-\$20k 	<ul style="list-style-type: none"> RCA Cost = \$15k Warranty Claim – Denied. Improper conduit entry. Replace inverter. Cost = \$9k Repair conduits and inverters site-wide. \$53k Lost production = \$23,076
The Costs	<ul style="list-style-type: none"> Cost = \$2,000 / \$0 	<ul style="list-style-type: none"> Cost = \$10k-\$20k 	<ul style="list-style-type: none"> Cost = \$100,076 +
	Total = \$2,000 / \$0	Total = \$53,000 / \$0	Total = \$100,076 +

What Are The Costs? – Connectors

What happens if you incorrectly spec or install connectors?

Example System:

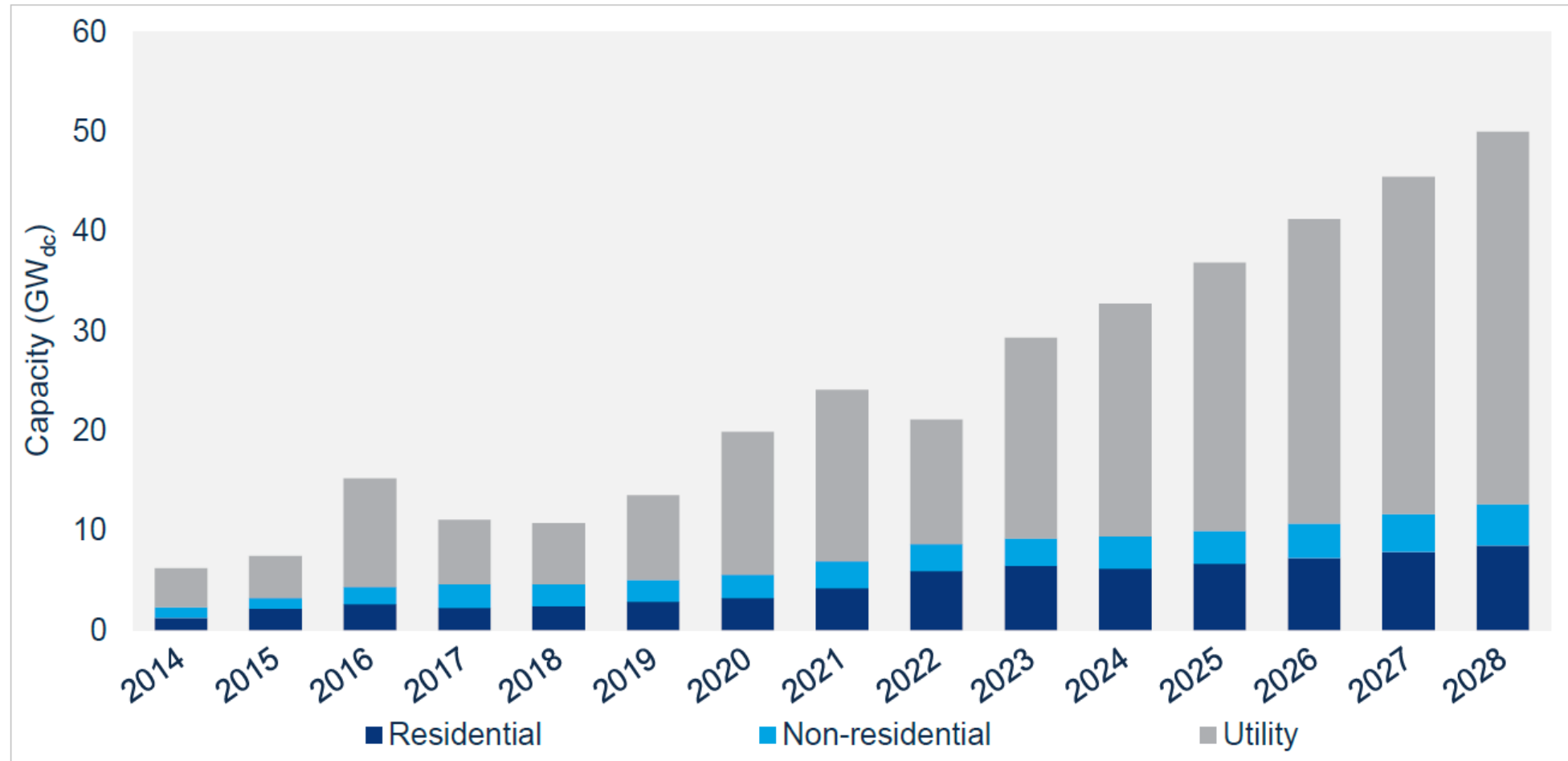
1 MW – Flat Roof

20 yr Life

	Discovered During Design Diligence	Discovered During Construction Phase	Discovered During Operations
The Issue	<ul style="list-style-type: none"> Engineer discovers cross-mated connectors on spec sheet. 	<ul style="list-style-type: none"> During site commissioning, inspector notices cross-mated connectors on homeruns 	<ul style="list-style-type: none"> You get the call that your site had a thermal event. Cross-mated connectors started a fire
The Effects	<ul style="list-style-type: none"> Engineer issues revised drawings with specification notes modified. Cost \$3,000 	<ul style="list-style-type: none"> New connector parts ordered. 2 wk delay + Cost = \$1,000 Design Engineer revises as-builts. Cost = \$3,000 Contractor replaces 200 field-made connectors = \$5,700 	<ul style="list-style-type: none"> RCA to determine Cause. Cost = \$20,000 Site shut down entirely for 2 months. Lost Production = \$103,846 2 Inverters and 200 kW modules total loss. Remove, Replace, Recommission = \$248,000 13,000 SF of Roof and Deck heavily damaged. Roof Restoration = \$180,556
The Costs			
	Total = \$3,000	Total = \$9,700	Total = \$543,940

Rapidly Growing Industry Means Lots of Inexperienced Installers

US solar PV installations and forecasts by segment, 2014-2028



Source: Wood Mackenzie



Thank You

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Q&A



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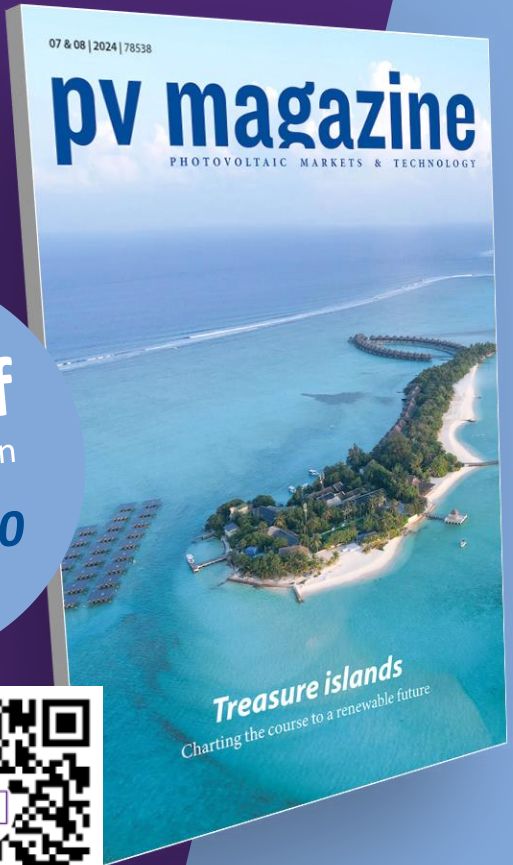


Ankil Sanghvi
Senior Engineering Manager
CEA

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12 GW of utility-scale solar deployed in first half of 2024, doubling 2023
by John Fitzgerald Weaver



U.S. module manufacturers seek “critical” retroactive tariffs
by John Fitzgerald Weaver



Coming up next...

Tuesday, 27 August 2024

1:00 pm – 2:00 pm BST, London

2:00 pm – 3:00 pm CEST, Berlin, Paris, Madrid

Thursday, 29 August 2024

1:00 pm – 2:00 pm BST, London

2:00 pm – 3:00 pm CEST, Berlin, Paris, Madrid

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